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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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*Ex parte* XIAOCHUN ZHU, STEVEN M. MILLENDORF, XU GUO,  
DAVID MERRILL JACOBSON, KANGHO LEE, SEUNG H. KANG, and  
MATTHEW MICHAEL NOWAK

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Appeal 2017-000529  
Application 14/077,093  
Technology Center 2400

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Before KRISTEN L. DROESCH, CATHERINE SHIANG, and  
MELISSA A. HAAPALA, *Administrative Patent Judges*.

SHIANG, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's rejection of claims 1–30, which are all the claims pending and rejected in the application. We have jurisdiction under 35 U.S.C. § 6(b). We affirm-in-part.

STATEMENT OF THE CASE

*Introduction*

According to the Specification, the present invention relates to physically unclonable functions. *See generally* Spec. 1. Claim 1 is exemplary:

1. A method for implementing a physically unclonable function (PUF) using an array of magnetoresistive random-access memory (MRAM) cells having magnetic tunnel junctions with randomly-varying resistances, comprising:

issuing a challenge by applying a physically unclonable function (PUF) challenge signal to a particular array of magnetoresistive random-access memory (MRAM) cells having a plurality of magnetic tunnel junctions, the challenge signal specifying a plurality of MRAM cell addresses of at least some of the magnetic tunnel junctions of the particular array; and

obtaining a physically unclonable function (PUF) response to the challenge by ascertaining a resistance of the magnetic tunnel junctions of the plurality of MRAM cell addresses of the particular array to generate a physically unclonable function (PUF) signal representative of at least a partial map of the particular array that identifies the particular array and distinguishes the particular array from other similar arrays.

#### *References and Rejections*

Claims 1–9, 11–14, and 16–29 are rejected under 35 U.S.C. § 103 as being unpatentable over Sakata (US Patent Publication No. 2004/0042292 A1; published Mar. 4, 2004) and Christensen (US Patent Publication No. 2012/0106235 A1; published May 3, 2012).

Claims 10, 15, and 30 are rejected under 35 U.S.C. § 103 as being unpatentable over Sakata, Christensen, and Chen (US Patent Publication No. 2006/0265733 A1; published Nov. 23, 2006).

#### ANALYSIS<sup>1</sup>

On this record, the Examiner did not err in rejecting claim 1.

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<sup>1</sup> To the extent Appellants advance new arguments in the Reply Brief without showing good cause, Appellants have waived such arguments. *See* 37 C.F.R. § 41.41(b)(2).

We agree with and adopt the Examiner’s findings and conclusions in (i) the action from which this appeal is taken and (ii) the Answer to the extent they are consistent with our analysis below.

Appellants contend there is no reasonable independent motivation to combine the references as proposed by the Examiner. *See* App. Br. 11–13; Reply Br. 1–3.

Appellants have not persuaded us of error. The U.S. Supreme Court has held “[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398, 416 (2007). Contrary to Appellants’ argument, “[i]f the claim extends to what is obvious, it is invalid under § 103” and “the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.” *Id.* at 418–19.

The Examiner finds—and Appellants do not dispute—that except for the claimed “physically unclonable function (PUF),” Sakata teaches all the claim elements of claim 1. *See* Final Act. 3–4. The Examiner finds—and Appellants acknowledge—that Christensen teaches the claimed “physically unclonable function (PUF).” *See* Final Act. 4; *See* App. Br. 12.

While not relied on for our analysis, we note Appellants acknowledge PUF was well known in the art. *See* Spec. ¶¶ 2–4. In fact, Appellants acknowledge this invention relates to the known field of PUFs. *See* Spec. ¶ 2.

The Examiner has provided articulated reasoning with a rational underpinning as to why one skilled in the art would have found it obvious to

modify Sakata’s method to incorporate Christensen’s teaching of PUF. *See* Final Act. 5. In particular, the Examiner finds Sakata and Christensen are analogous art, and determines one skilled in the art would have found it obvious to modify Sakata’s method to incorporate Christensen’s teaching of PUF, so that the modified method can be “used in applications with high security requirements.” Final Act. 5.

Appellants do not persuasively show why such reasoning is insufficient. In particular, Appellants’ citing *Interconnect Planning Corp. v. Feil*, 774 F.2d 1132, 227 USPQ 543 (Fed. Cir. 1985) (App. Br. 12–13; Reply Br. 2–3)—a case predating *KSR*—is unhelpful. Consistent with *KSR* and *Interconnect*, and as discussed above, the Examiner explains why one skilled in the art would have modified Sakata’s method to incorporate Christensen’s teaching of PUF, and Appellants fail to show why that reasoning is insufficient.

Further, Appellants’ assertion that “the capacitance approach of Christensen and the resistance approach of Sakata are technically inconsistent and not combinable” (App. Br. 12) is unpersuasive of error, because Appellants do not provide persuasive argument or objective evidence to show the argued conclusion is warranted. In particular, the Examiner’s proposed combination incorporates Christensen’s teaching of PUF, but not the specific implementation described in a specific sentence of paragraph 6 of Christensen (“A random variation of memory cell capacitance is used to implement the physically unclonable function”), as Appellants argue (App. Br. 12). In fact, Christensen generally states PUFs were well known in the art and “are the hardware analog of a one-way function, or essentially random functions bound to a physical device in such

a way that it is computationally and physically infeasible to predict the output of the function without actually evaluating it using the physical device.” Christensen ¶¶ 1, 3. Further, Christensen cautions: “While the present invention has been described with reference to the details of the embodiments of the invention shown in the drawing, these details are not intended to limit the scope of the invention as claimed in the appended claims.” Christensen ¶ 35. In short, Appellants have not shown that the teachings of Sakata and Christensen are “not combinable” (App. Br. 12) in the form proposed by the Examiner. And Appellants’ assertion that “[T]here is simply no teaching of in either Sakata or Christensen of substituting the memory cell capacitance PUF for using ‘a resistance of the magnetic tunnel junctions’ for the PUF” (App. Br. 13) is not directed to the specific combination proposed by the Examiner.<sup>2</sup>

The Examiner’s findings and conclusion are reasonable because the skilled artisan would “be able to fit the teachings of multiple patents together like pieces of a puzzle” since the skilled artisan is “a person of ordinary creativity, not an automaton.” *KSR*, 550 U.S. at 420–21. Appellants do not present adequate evidence that the resulting arrangements would have been “uniquely challenging or difficult for one of ordinary skill in the art” or

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<sup>2</sup> Appellants’ assertion that “there are several possible ways in which Sakata . . . and Christensen . . . may be combined, but none of those ways necessitates the combination of the claimed elements” (App. Br. 13) is conclusory and do not provide evidence to show error. Further, Appellants have not cited any legal authority for their argued “necessitates” test. To the contrary, “[t]he proper question to have asked was whether a [person] of ordinary skill, facing the wide range of needs created by developments in the field of endeavor, would have seen a benefit to [modifying Sakata with a PUF].” *KSR*, 550 U.S. at 424.

“represented an unobvious step over the prior art.” *Leapfrog Enters., Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007) (citing *KSR*, 550 U.S. at 418–19).

In the Reply Brief and for the first time, Appellants belatedly argue:

. . . there is no teaching in Sakata of a circuit to measure memory cell resistance (upon providing a challenge) in order to generate the PUF. In fact, short of Applicant’s specification, no reference has been cited that would provide a motivation to us[e] memory cell resistance to obtain a PUF as claimed.

Reply Br. 3. Appellants have waived such arguments because they are untimely, and Appellants have not demonstrated any “good cause” for the belated presentation. *See* 37 C.F.R. § 41.41(b)(2).

Accordingly, we agree with the Examiner that applying Christensen’s teaching of a well-known PUF to Sakata’s method would have predictably used prior art elements according to their established functions—an obvious improvement. *See KSR*, 550 U.S. at 417; Final Act. 5.

Because Appellants have not persuaded us the Examiner erred, we sustain the Examiner’s rejection of independent claim 1, and independent claims 11, 16, and 22 for similar reasons.

We also sustain the Examiner’s rejection of corresponding dependent claims 2, 4–8, 10, 12, 13, 15, 17–20, and 24–30, as Appellants do not advance separate substantive arguments about them.

Regarding dependent claims 3, 14, 21, and 23, we agree with Appellants that the Examiner has not adequately mapped the claimed “wherein the MRAM cells are uninitialized when the response is obtained.” *See* App. Br. 13–15; Reply Br. 3–4. The Examiner cites Sakata’s paragraphs 4 and 64 (Final Act. 5; Ans. 4–5), but the cited paragraphs do not teach or

suggest the disputed claim limitation. Therefore, we are constrained by the record to reverse the Examiner's rejection of claims 3, 14, 21, and 23.

Regarding dependent claim 9, we agree with Appellants that the Examiner has not adequately mapped the claimed "altering at least one of the generated resistance difference values . . . *in order to increase a level of complexity*" (emphasis added). *See* App. Br. 15–16; Reply Br. 4–5. The Examiner cites Sakata's paragraphs 5 and 6 (Final Act. 7; Ans. 5), but the cited paragraphs do not teach or suggest the italicized claim limitation. Therefore, we are constrained by the record to reverse the Examiner's rejection of claim 9.

#### DECISION

We affirm the Examiner's decision rejecting claims 1, 2, 4–8, 10–13, 15–20, 22, and 24–30.

We reverse the Examiner's decision rejecting claims 3, 9, 14, 21, and 23.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED-IN-PART